Cost-Benefit Analysis of Climate Policy

EES 3310/5310

Global Climate Change

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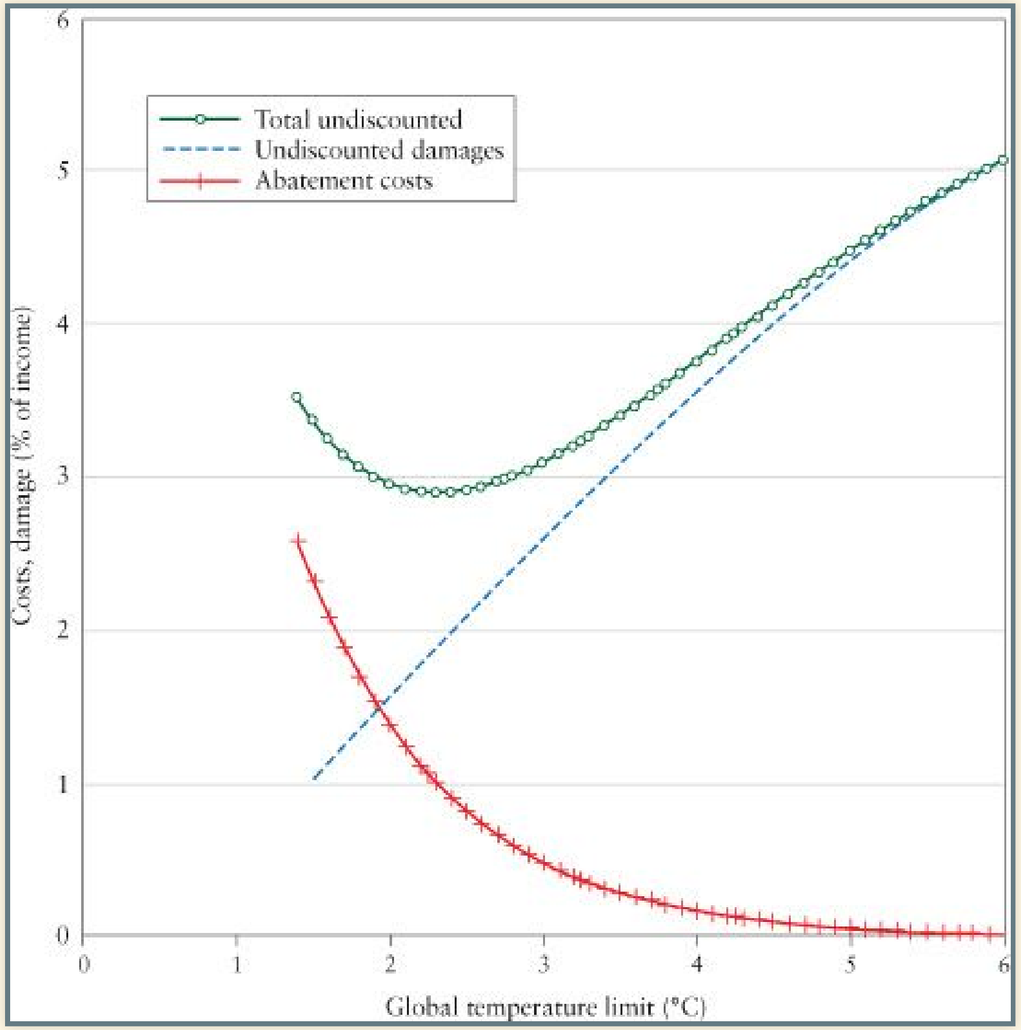
Class #30: Friday, March 27 2020

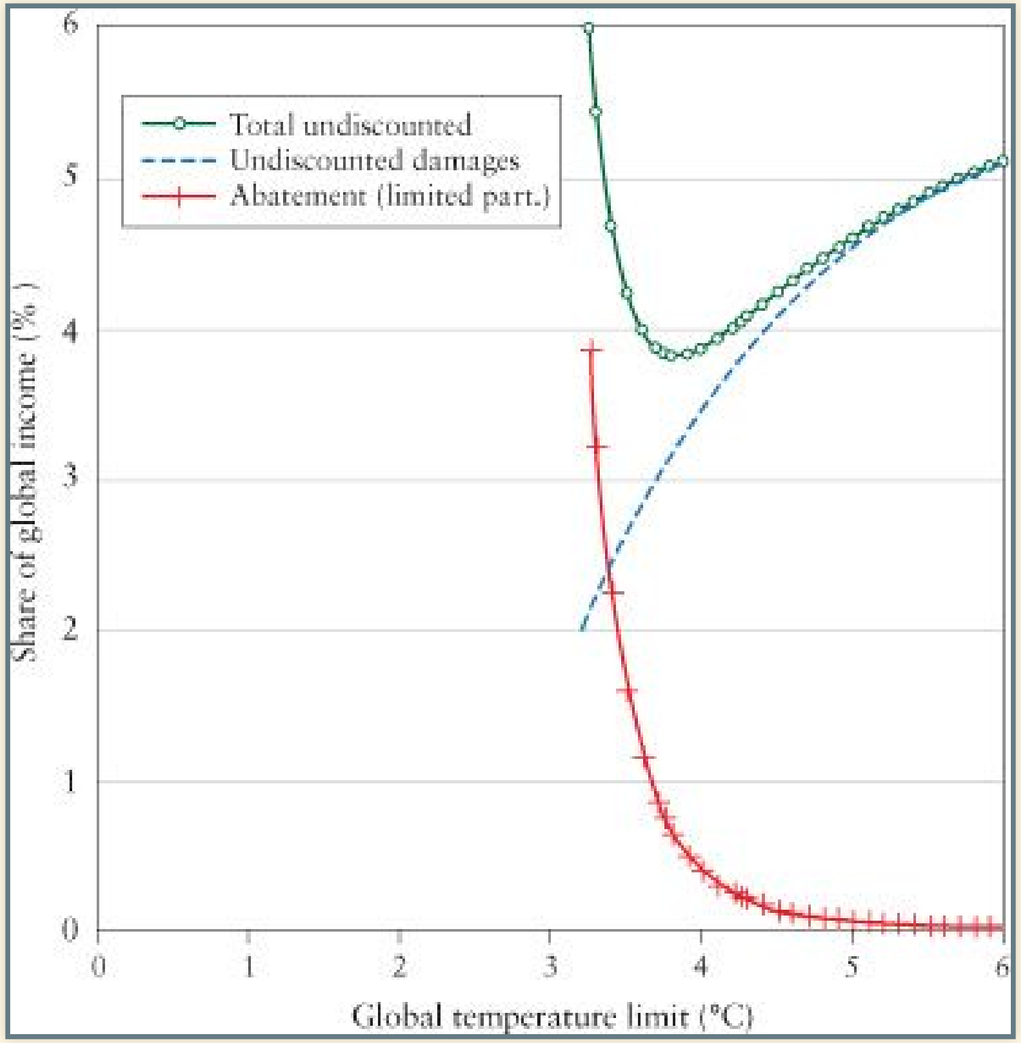
Climate Casino

Climate Casino

Optimal Policy: 100% efficient



Inefficient: Limited Participation



Climate Casino

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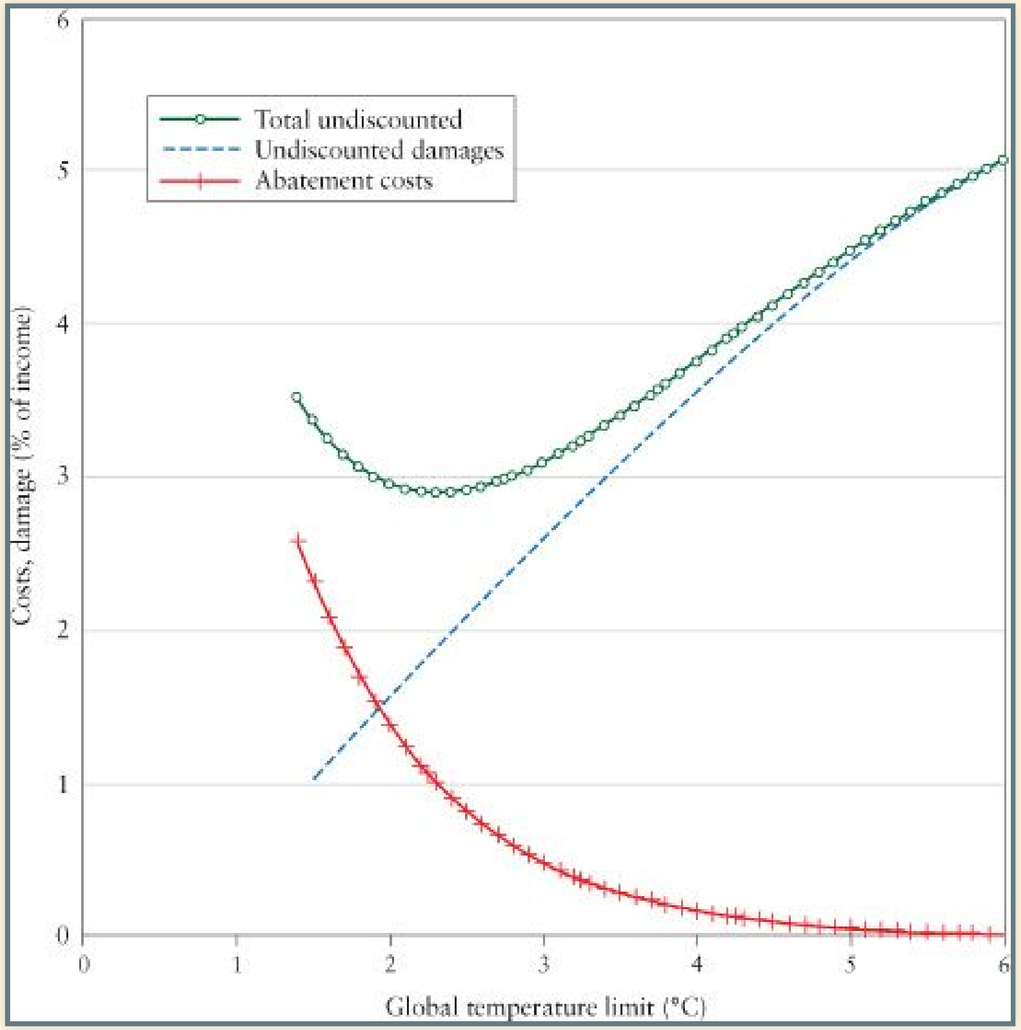
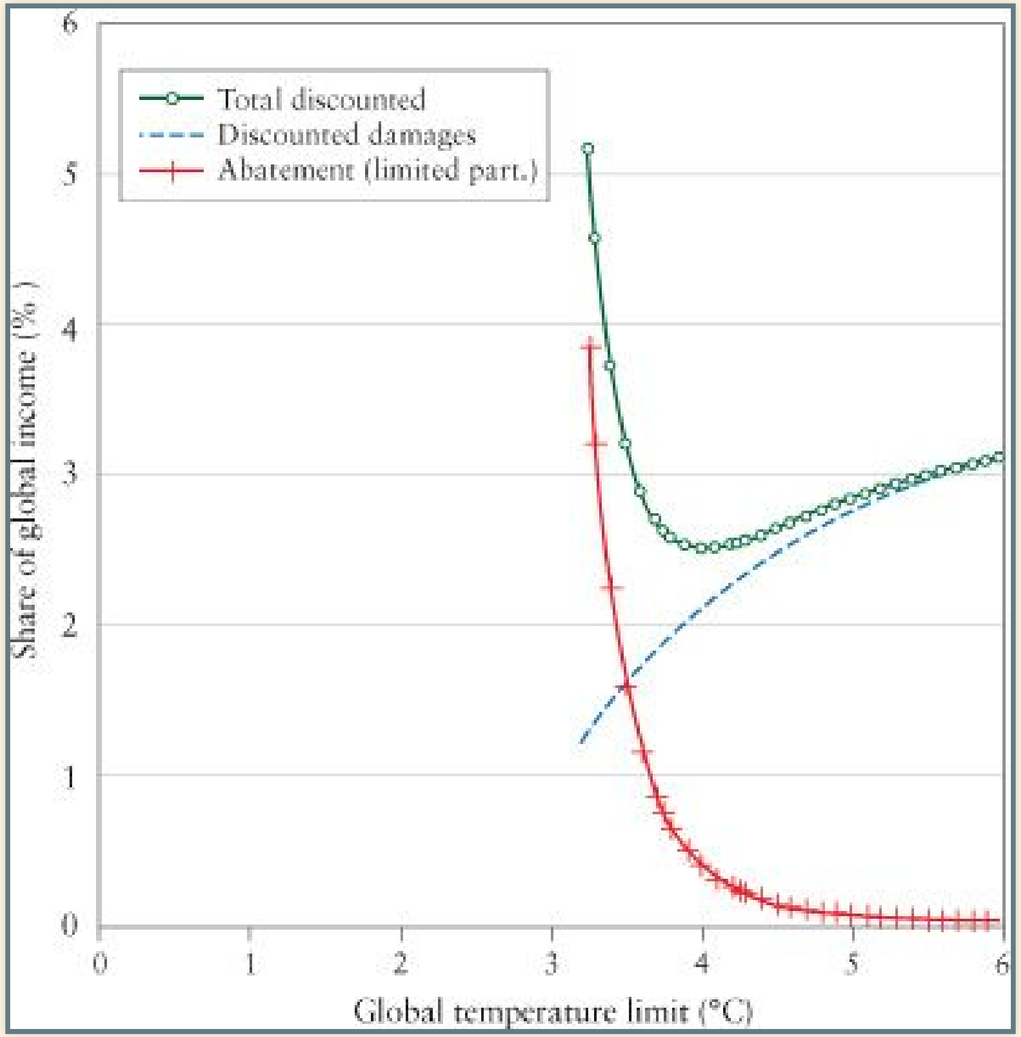


Limited Participation with Discounting



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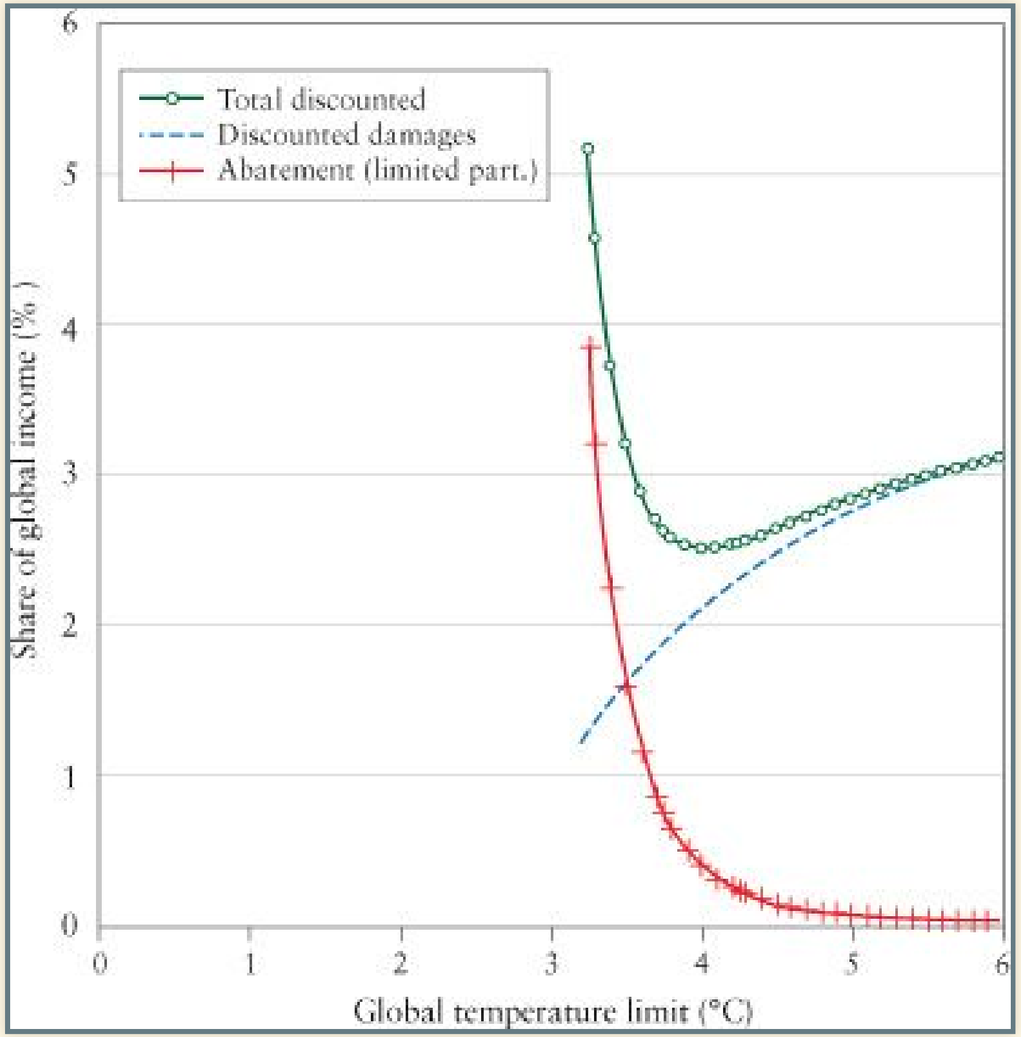
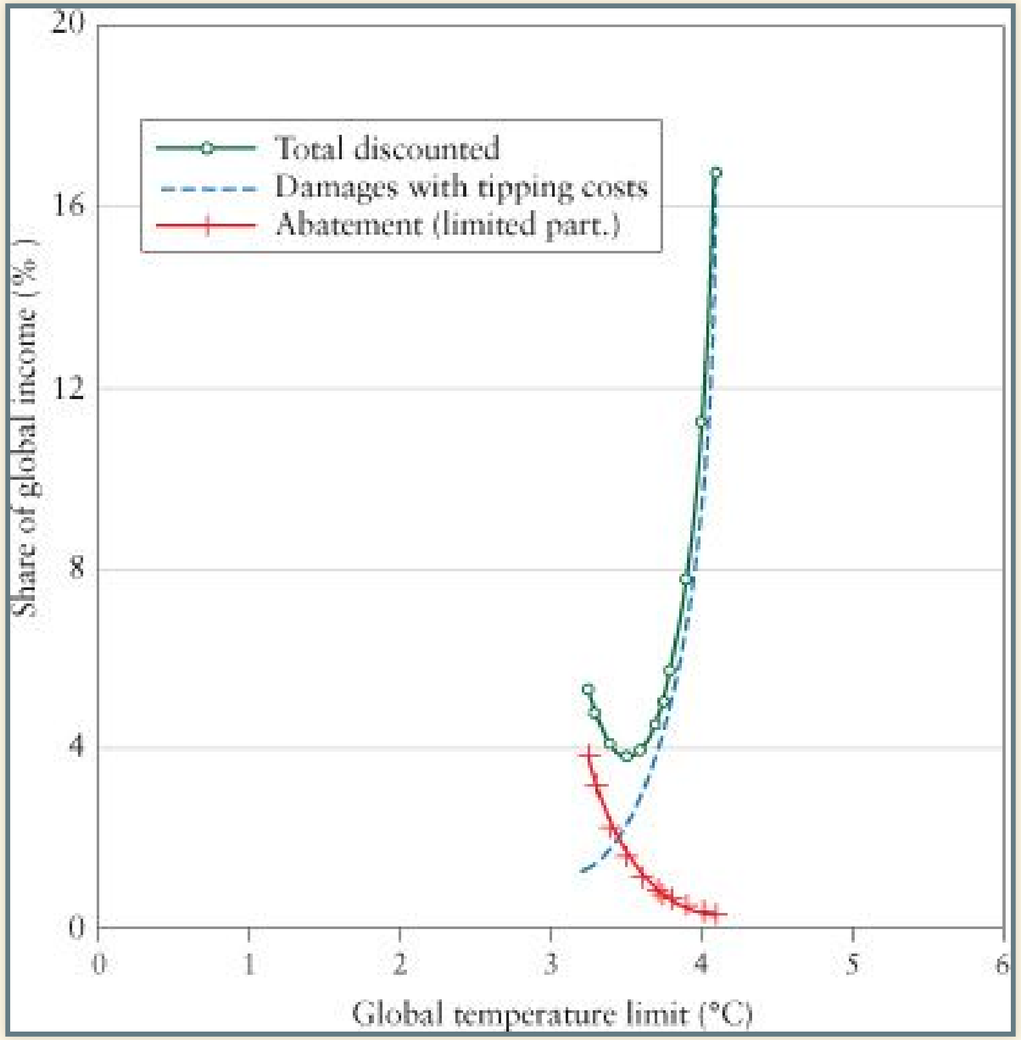
Limited Participation with Discounting



Limited Participation with Discounting and Tipping Points



Summary of Principles:

- Higher damages with higher temperatures
- Higher costs of emissions abatement for lower temperature targets
- Higher costs when participation is limited and abatement is inefficient
- Lower damages when you account for discounting
- Tipping points can change everything

Microeconomics and Emissions Reduction

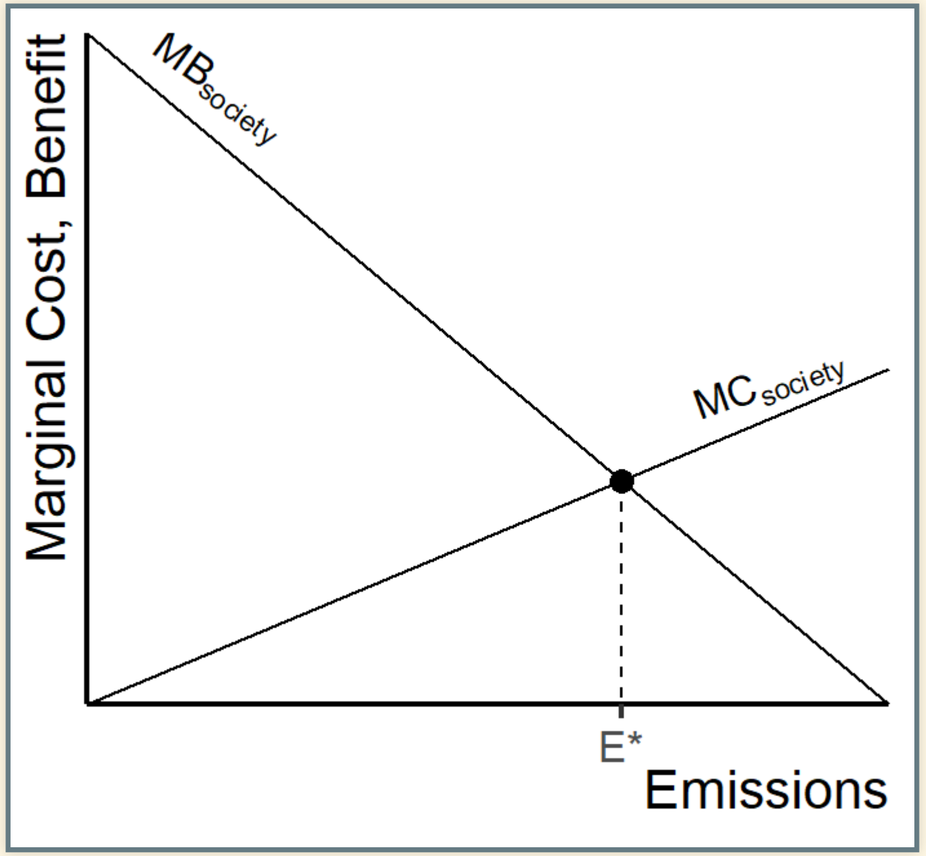
Technical Microeconomics

- Marginal costs and benefits:
  - iPhones:
    - Billions of dollars to build the first iPhone
    - Less than $500 to build the millionth iPhone
  - Production possibilities:
    - Economies of scale
      - Marginal costs fall as volume increases
    - Diminishing returns:
      - Marginal costs rise as volume increases
- Gross costs:
  - Sum of marginal costs for all units produced

Using Graphs to Avoid Math

- Costs vs. benefits for increasing CO_2 abatement
- MC = marginal cost to society of emissions (pollution)
- MB = marginal benefit of emissions (economic output)

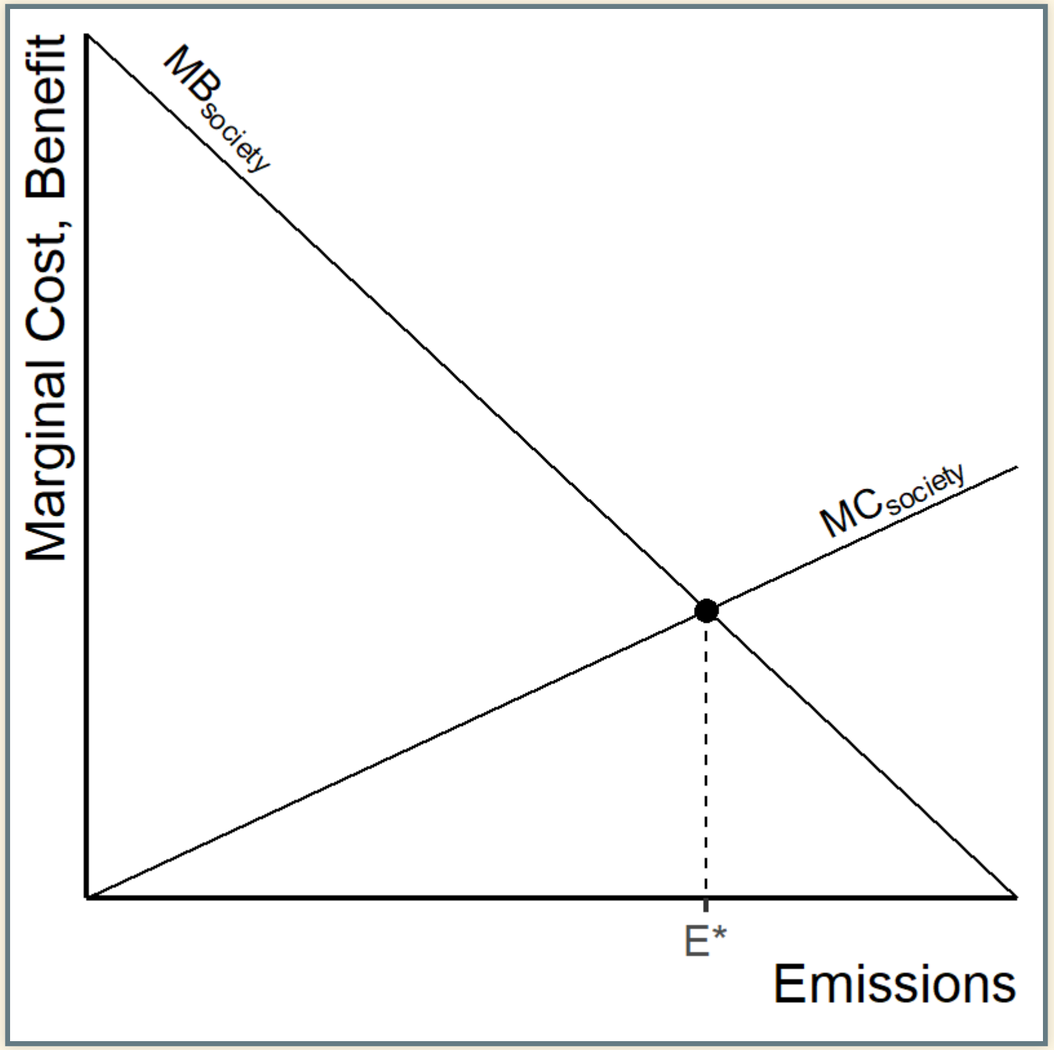
- When MC > MB, it's worth cutting emissions.
- When MC < MB, cutting emissions costs more than it's worth.
- When MC = MB: equilibrium, optimal amount of emissions.



Slope of MB

- Costs vs. Benefits of Emissions

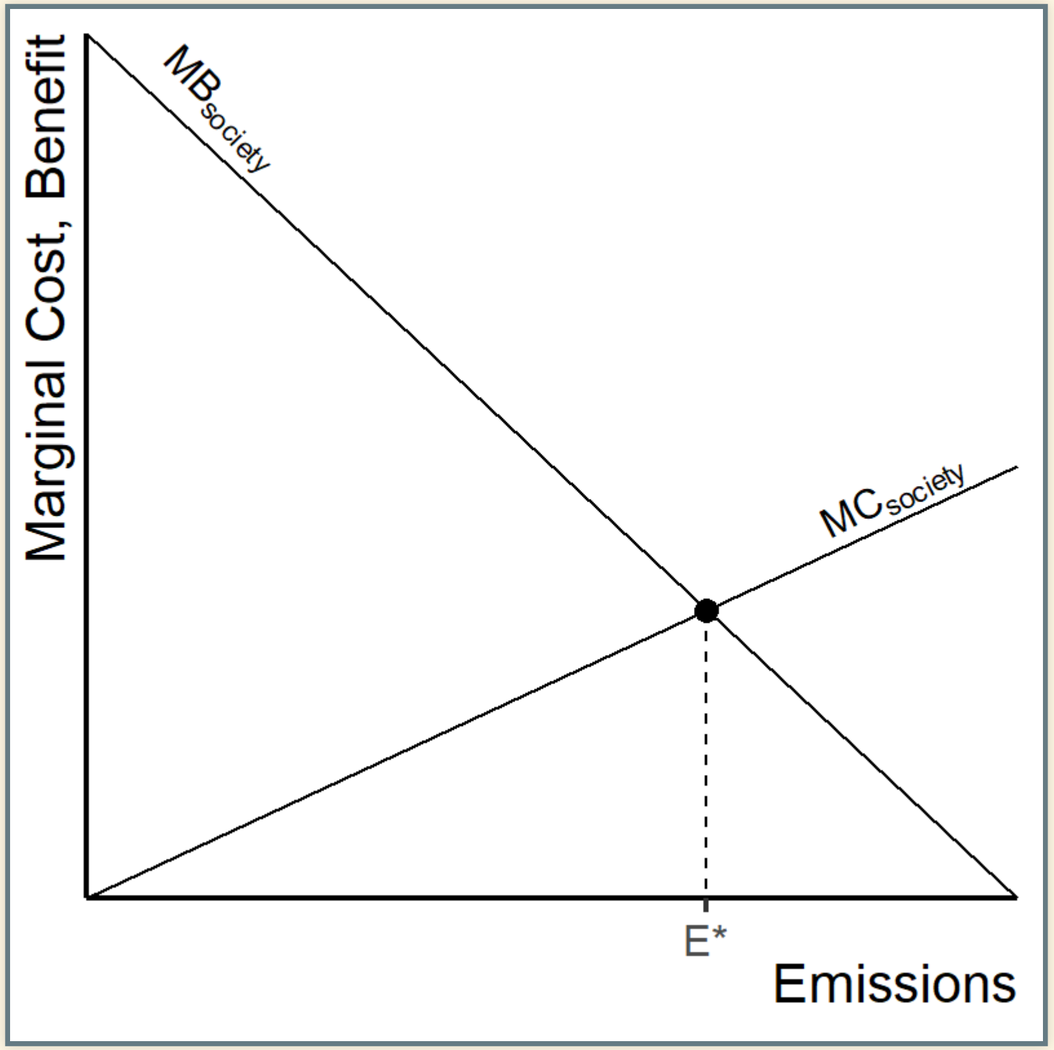
- Why does MB slope down?
  - Optimal emissions:
    - When energy is plentiful, diminishing returns on using more
    - Implications for cutting emissions:
      - Marginal benefit of emissions = marginal cost of cutting emissions.
      - Do cheap things first (small marginal cost to reduce emissions)
      - When you run out of cheap things, turn to expensive ones



Slope of MC

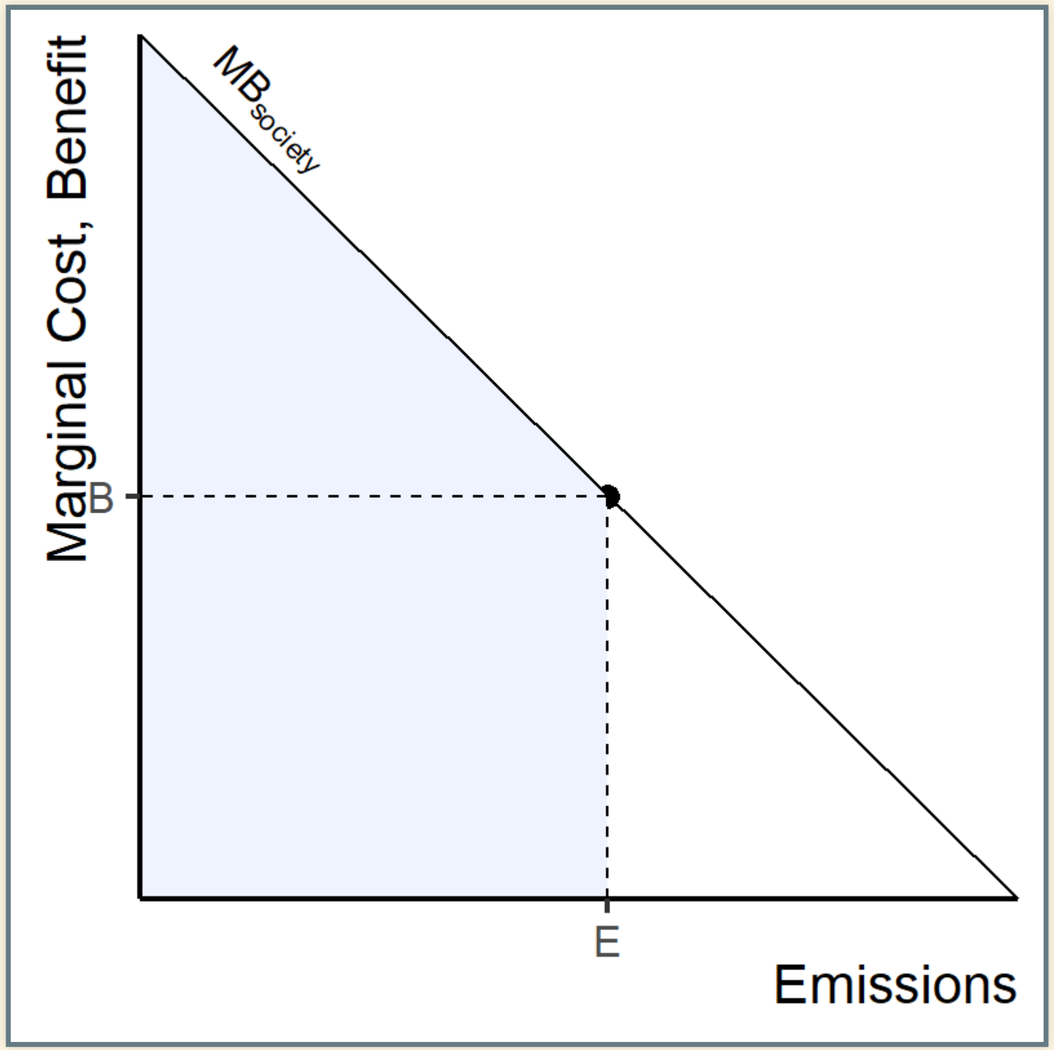
- Costs vs. Benefits of Emissions

- Why does MC slope up?
  - Greater emissions mean more warming
  - Greater warming = greater damage:
    - Going from 3°C to 4°C is much worse than going from 2°C to 3°C
    - Benefit of reducing warming from 4°C to 3°C is worth more than reducing it from 3°C to 2°C



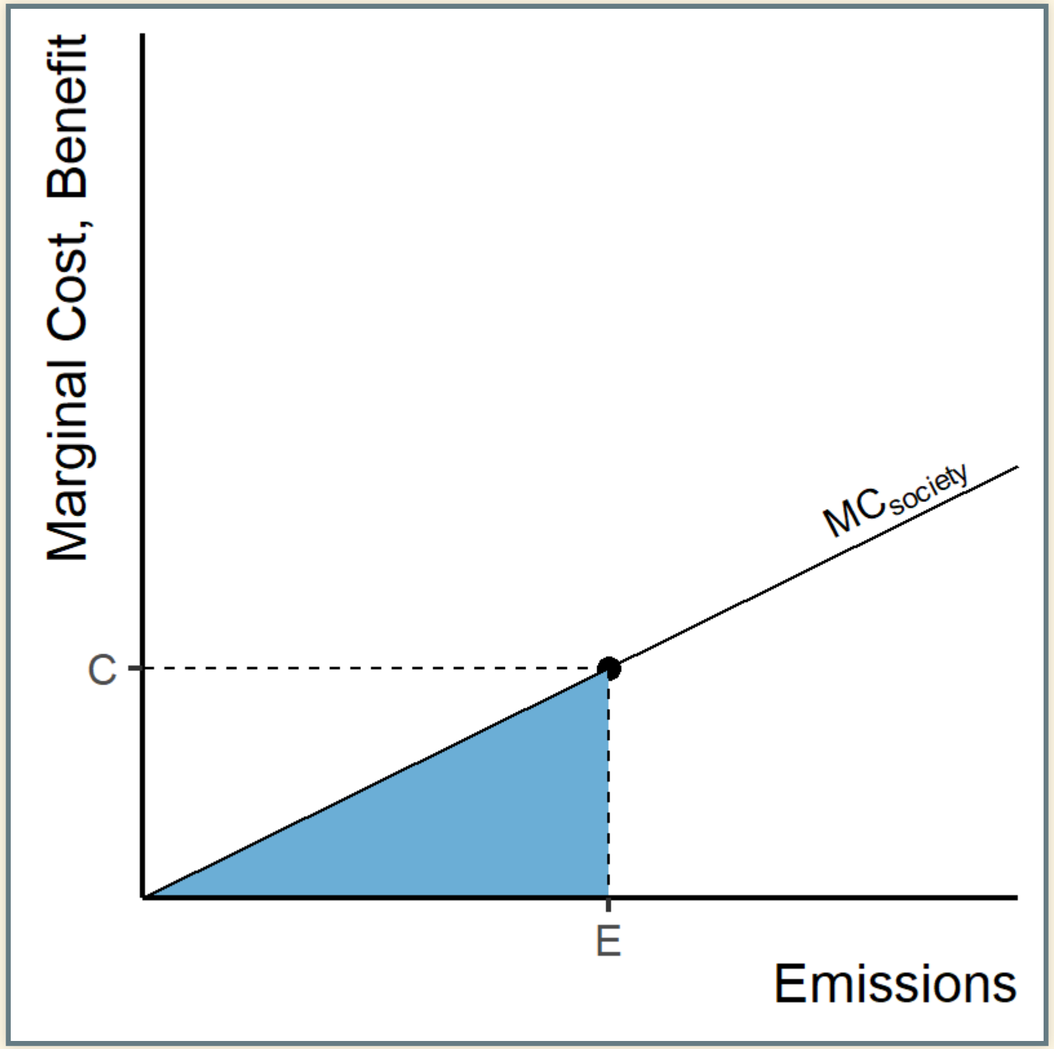
Marginal vs. Gross Benefit

- E = emissions (abatement)
- B = marginal benefit
- Blue area = total gross benefit to society from emissions



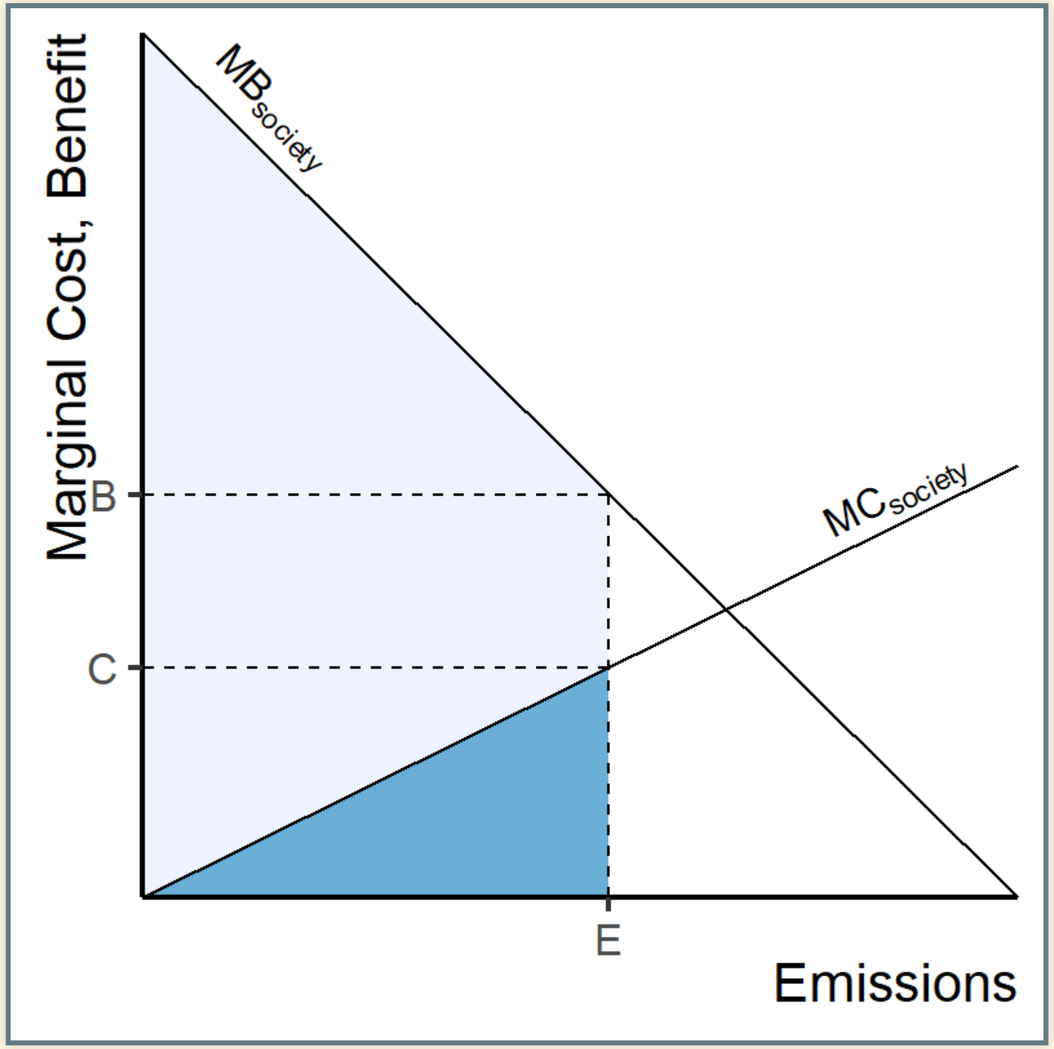
Marginal vs. Gross Cost

- E = emissions (abatement)
- C = marginal cost
- Blue area = total gross cost to society from emissions



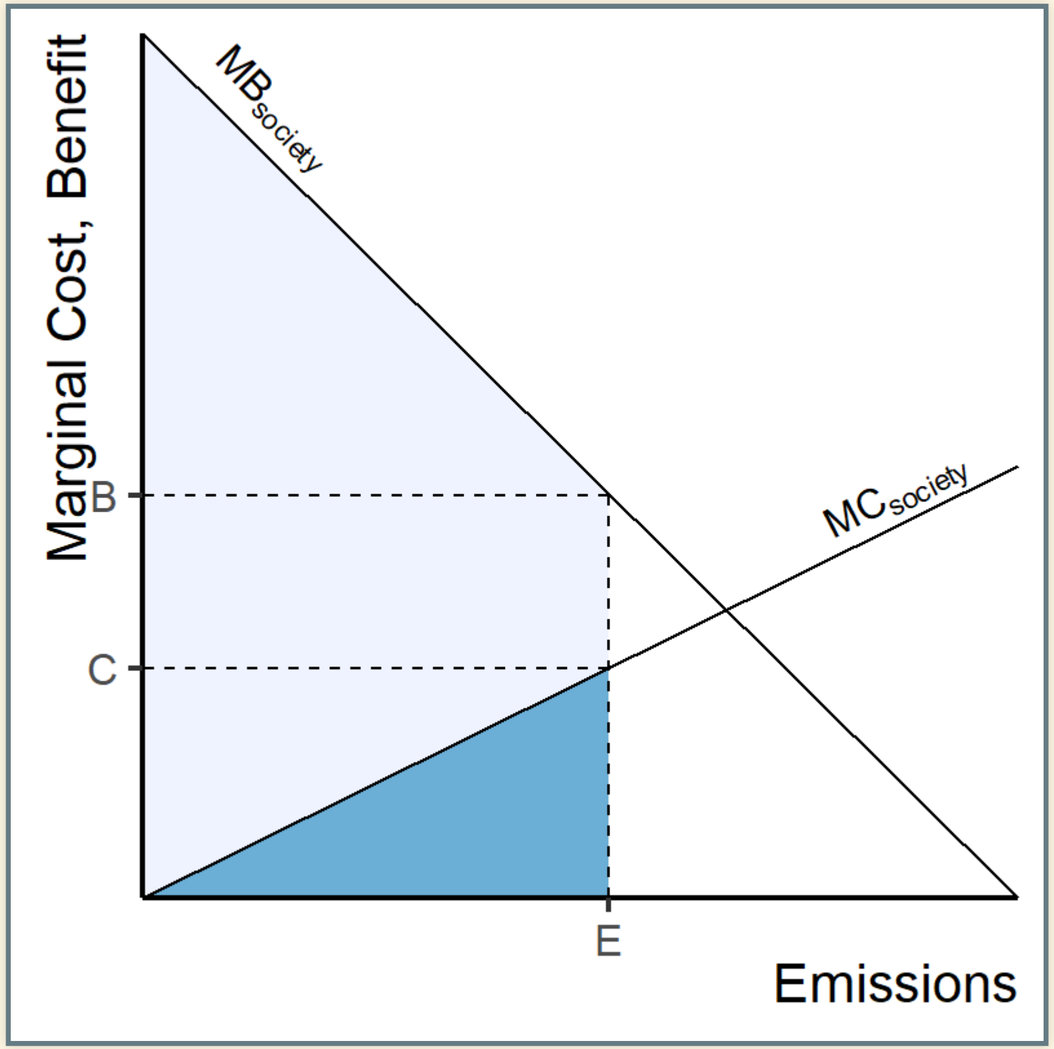
Putting it Together

- Marginal benefit at E = B
- Marginal cost at E = C
- Marginal net benefit at E = (B - C)

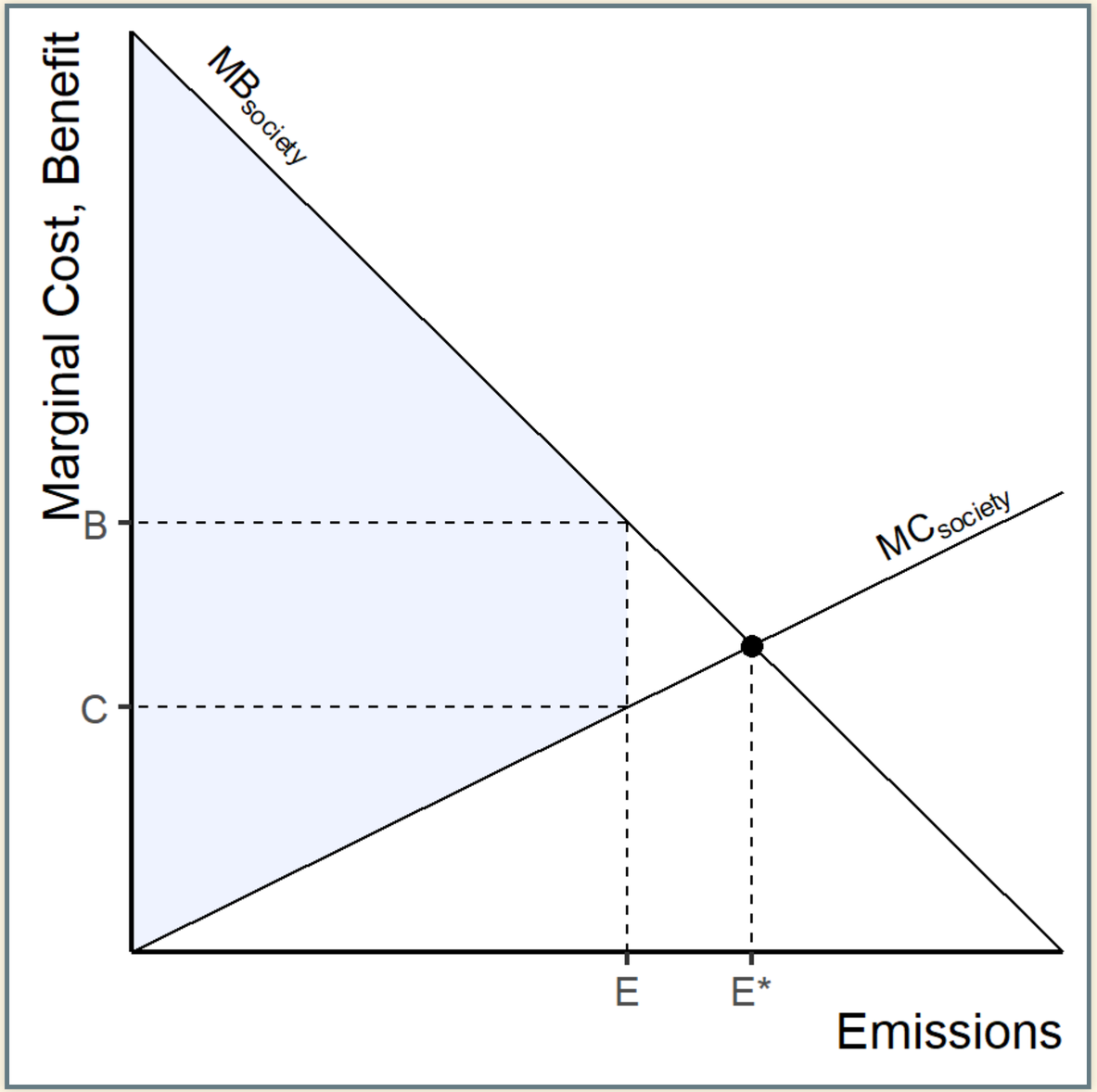


Putting it Together

- Gross benefit at E = area under MB (light + dark blue)
- Gross cost at E = area under MC (dark blue)
- Gross net benefit at E = gross benefit - gross cost
  - Light-blue trapezoid



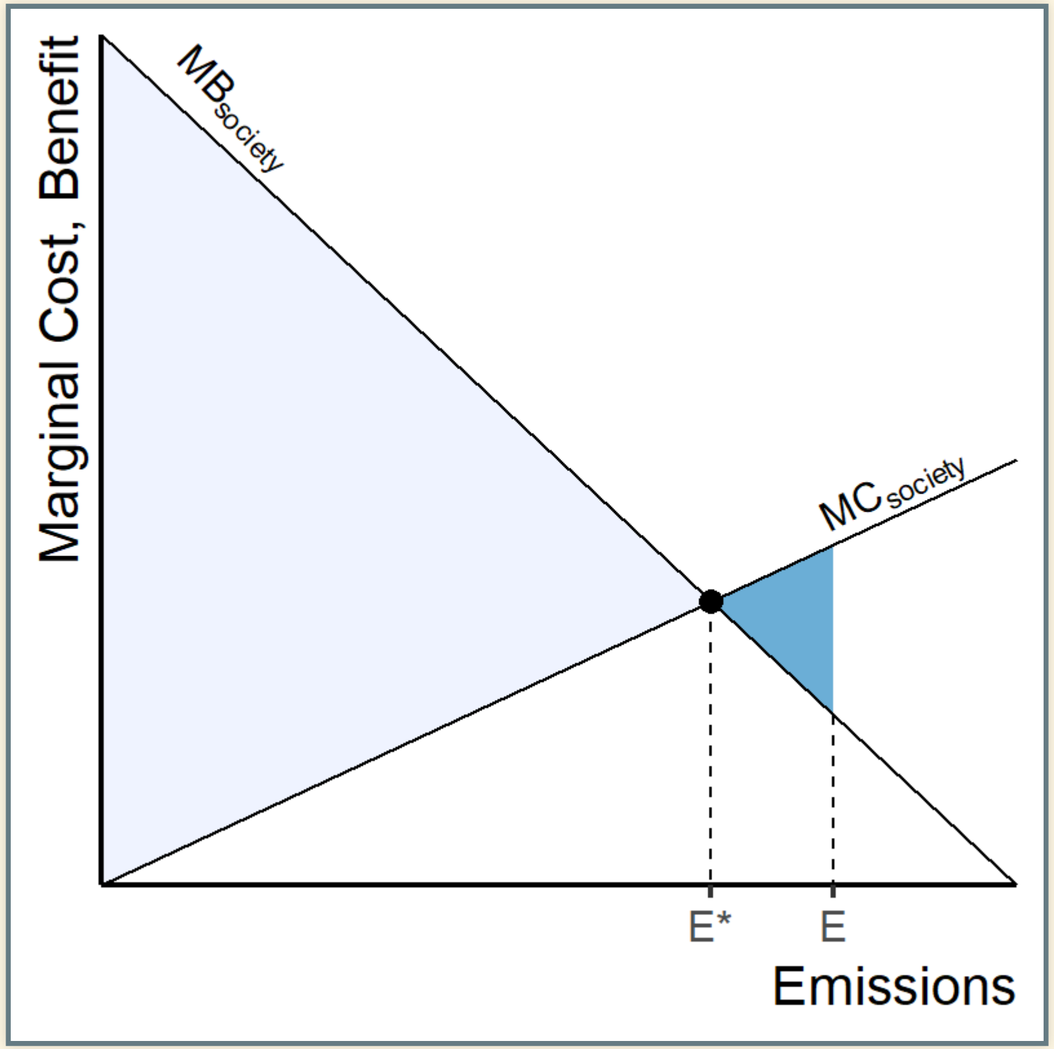
Total Net Benefit



Optimizing Emissions

Optimum Emissions

- Optimum emissions = E*
- Actual emissions = E
- Little triangle on right:
  Costs > Benefits (net loss)
- EPA issues only enough permits to allow emissions of E*
- Free trading in permits cuts emissions to E* at lowest possible cost
- Total net benefits to society are maximized.



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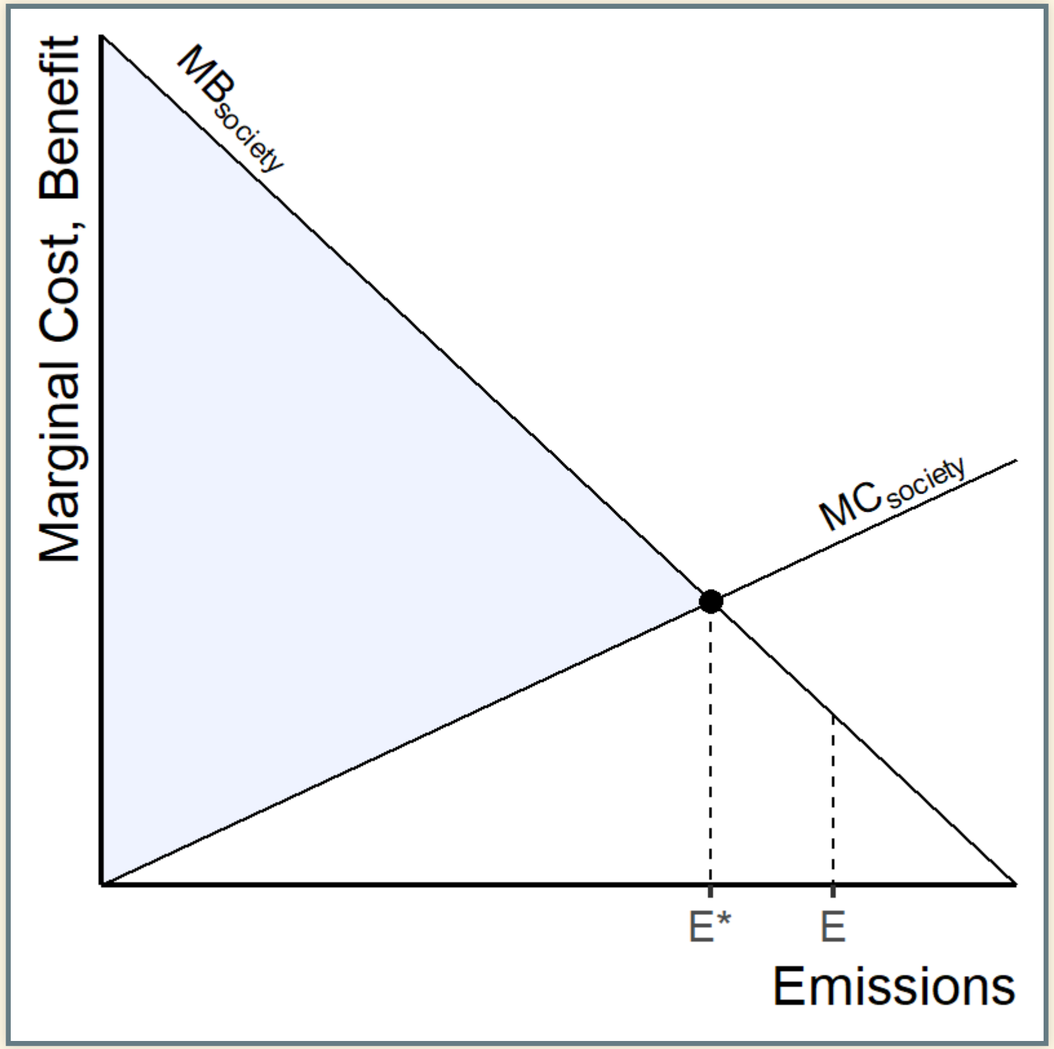
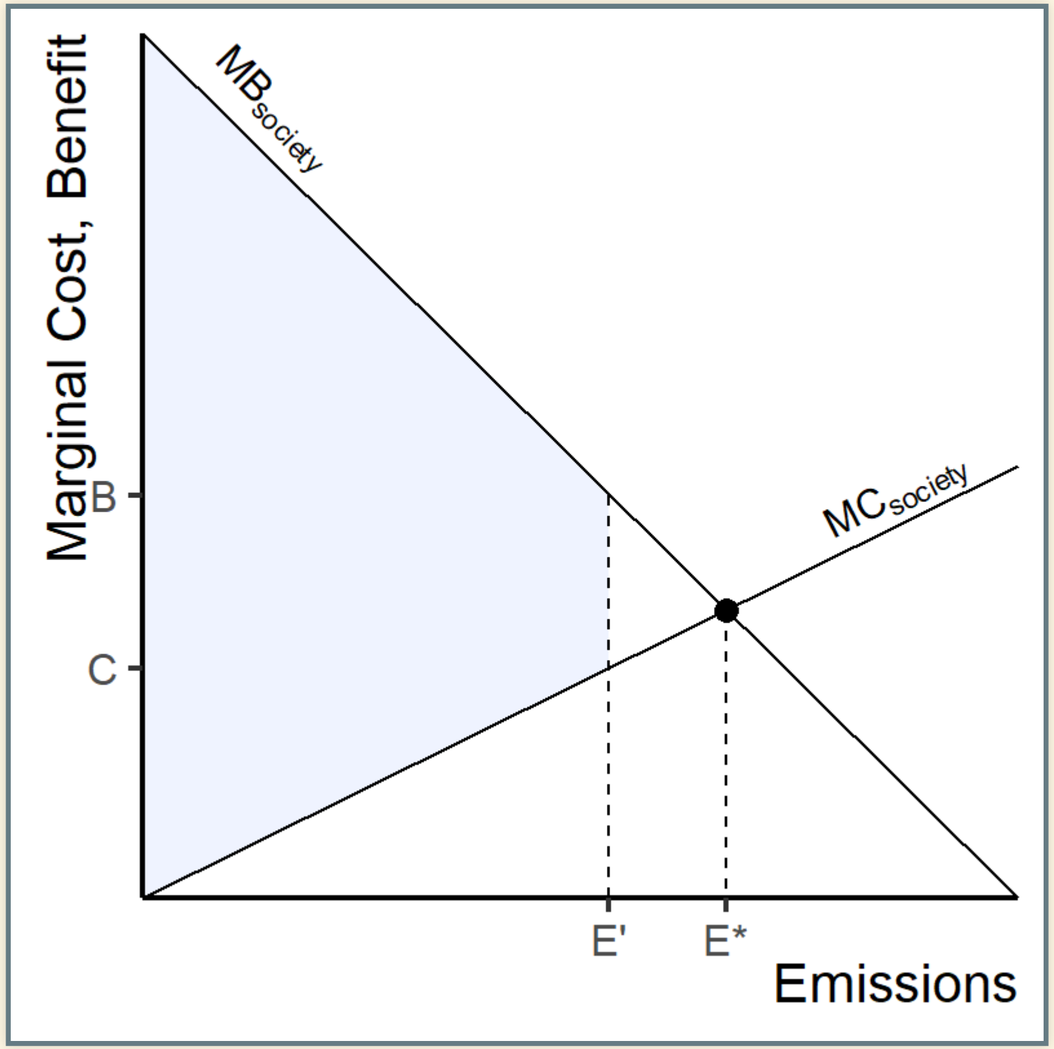


Deadweight Losses

- Optimum: E*
- EPA cuts emissions too far, to E’
- Deadweight loss = empty triangle (difference between actual net benefit and optimum net benefit).



Deadweight Losses

- Optimum: E*
- EPA cuts emissions too far, to E’
- Deadweight loss = blue triangle (difference between actual net benefit and optimum net benefit).